Anekant Education Society's

Tuljaram Chaturchand College
of Arts, Science and Commerce, Baramati
(Empowered Autonomous)

Three/Four Year Honours/ Honours with Research B.Sc. Degree

Program in Physics

(Faculty of Science)

CBCS Syllabus

S.Y.B.Sc. (Physics) Semester – IV

For

Department of Physics

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Choice Based Credit System Syllabus

(2024 Pattern)

(As Per NEP- 2020)

To be implemented from Academic Year 2025-2026

Title of the Programme: S.Y.B.Sc. (Physics)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2024 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP) 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Physics and related subjects, the Board of Studies in Physics at Tuljaram Chaturchand College, Baramati - Pune has developed the curriculum for the first semester of S.Y.B.Sc. Physics, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023 and the Circular issued by SPPU, Pune on 31st May 2023. Physics is concerned with the study of the universe from the smallest to the largest scale: it is about unraveling its complexities to discover the way it is and how it works. Discoveries in physics have formed the foundation of countless technological advances and play an important role in many scientific areas. Many techniques used in medical imaging, nanotechnology and quantum computing are derived from physics instrumentation. Even the World Wide Web was a spin-off from the information processing and communications requirements of high-energy particle physics. The contributions of physics to solving global problems such as energy production, environmental protection, global warming and public health are essential and have an enormous impact on our society.

The systematic and planned curricula from first year to third year/fourth year honours shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

• Programme Specific Outcomes (PSOs)

PSO1: Understand basic mechanics and properties of matter

It refers to the ability of students to understand the fundamental concepts of mechanics and the properties of matter, such as force, motion, energy, elasticity, viscosity and surface tension. This knowledge helps in analyzing physical phenomena and solving practical problems in science and engineering.

PSO2: Illustrate the principles of electricity, magnetism, thermodynamics, optics and Spectroscopy

It focuses on understanding and applying the fundamental principles of electricity, magnetism, thermodynamics, optics and spectroscopy to explain various natural phenomena and technological applications, enabling students to solve problems and innovate in science and engineering.

PSO3: Identify, formulate and analyze complex problems using basic principles of mathematics, physics and statistics

It emphasizes the ability to identify, formulate, and analyze complex problems in science and engineering by applying fundamental principles of mathematics, physics, and statistics, enabling students to develop effective solutions.

PSO4: Design, construct and analyze basic electronic and digital circuits

This outcome focuses on developing the ability to design, construct, and analyze basic electronic and digital circuits using fundamental principles of electronics. It helps students to understand the working of various electronic components and systems, enabling them to apply their knowledge in practical applications.

PSO5: Understand the basics of programming language and apply it to various numerical problems

This outcome aims to develop a basic understanding of programming languages to solve various numerical and scientific problems. It helps students to apply computational methods and algorithms for problem-solving in physics and related fields. This skill enhances their analytical thinking and technical abilities, preparing them for research and practical applications.

PSO6: Develop effective communication skills

This outcome focuses on enhancing students' communication skills to effectively express their ideas, concepts, and research findings. It helps them to communicate clearly and confidently in both written and verbal forms, which is essential in academic and professional settings. Strong communication skills also improve their ability to collaborate, present, and share knowledge in scientific and technical fields.

PSO7: Develop experimental skills and independent work culture through a series of experiments that compliment theories and projects

This outcome aims to enhance students' experimental skills by conducting practical experiments that support and strengthen theoretical knowledge. It also encourages students to work independently, fostering a self-reliant and research-oriented work culture. Through hands-on experiments and projects, students gain practical experience, enabling them to apply scientific concepts effectively in real-world scenarios.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Board of Studies (BOS) in Physics

From 2025-26 to 2027-28

Sr. No.	Name	Designation
1	**Dr. Kale Rajendra Devidas** Head, Department of Physics, T. C. College, Baramati.	Chairperson
2	**Dr. Pathan H.M.** Associate Professor, Department of Physics, Savitribai Phule Pune University, Pune	Vice-Chancellor Nominee Subject Expert from SPPU, Pune
3	**Prof. Dr. Patil Vikas Baburao** Professor & Head, Department of Physics Punyashlok Ahilyadevi Holkar Solapur University, Solapur	Subject Expert from Outside the Parent University
4	**Dr. Patil Umakant Mahadev** Associate Professor, D.Y. Patil University, Kolhapur	Subject Expert from Outside the Parent University
5	**Mr. Bhabale Amar Ramesh** Head - Production Planning at Piaggio Vehicles Pvt. Ltd , Pune	Representative from industry/corporate sector/allied areas
6	**Mr. Mahanavar Balbhim Sahebrao** Assistant Professor, Department of Physics, Dada Patil Mahavidyalaya, Karjat	Member of the College Alumni
7	**Dr. Sapkal Ramchandra Tukaram** Associate Professor, Department of Physics, T. C. College, Baramati	Member
8	**Dr. Kulkarni Sachin Babasaheb** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
9	**Mr. Kakade Sandip Bhimrao** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
10	**Dr. Mohite Vijay Sampat** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
11	**Mrs. Bhosale Shubhangi Eknath** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
12	**Mr. Thorat Sopan Muralidhar** Assistant Professor, Department of Physics, T. C. College, Baramati	Member

13	**Mr. Shinde Pratik Kishor** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
14	**Mr. Madhare Pratik Laxman** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
15	**Miss. Jadhav Sai Vikas**	UG Student
16	**Miss. Phadtare Dnyaneshwari Rajendra**	PG Student

Department of Physics **S.Y.B.Sc. Semester-IV**

Credit Distribution Structure for Three/Four Year Honours/Honours with Research Degree Programme
With Multiple Entry and Exit options as per National Education Policy (2024 Pattern as per NEP-2020)

Level/ Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	**22**
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T)	**22**
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	**Sem**	**Credits Related to Major**				**Minor**	--	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CE P/RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	**22**
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	**22**
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	**22**
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	**22**
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	**22**
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with176 credits														

T = Theory **P** = Practical **DSC** = Discipline Specific Course **OE** = Open Elective **SEC** = Skill Enhancement Course

IKS = Indian Knowledge System **AEC** = Ability Enhancement Course **VEC** = Value Education Course **CC** = Co-curricular Course **VSC**= Vocational Skill Course

OJT= On Job Training **CEP**= Community Engagement Project **FP**= Field Project **RP**= Research Project

Course Structure for F.Y.B.Sc. (2024 Pattern) as per NEP-2020

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
I (4.5)	DSC-I (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-II (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-III (General)	PHY-101-GEN	Mechanics & Properties of Matter	T	02
		PHY-102-GEN	Physics Practical-I	P	02
	Open Elective (OE)	PHY-103-OE	Indian Astronomy-I	T	02
	ementSkill Enhanc Course (SEC)	PHY-104-SEC	Applications of Internet of Things-I	P	02
	Ability Enhancement Course (AEC)	ENG-104-AEC	Functional English-I	T	02
	Value Education Course (VEC)	ENV-105-VEC		T	02
	Generic Indian Knoweldge System (GIKS)	GEN-106-IKS		T	02
	Total Credits Semester-I				**22**
II (4.5)	DSC-I (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-II (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-III (General)	PHY-151-GEN	Heat and Thermodynamics	T	02
		PHY-152-GEN	Physics Practical –II	P	02
	Open Elective (OE)	PHY-153-OE	Indian Astronomy -II	P	02
	Skill Enhancement Course (SEC)	PHY-154-AEC	Applications of Internet of Things-II	P	02
	Ability Enhancement Course (AEC)	ENG-154-AEC	Functional English-II	T	02
	Value Education Course (VEC)	COS-155-VEC		T	02
	Co-curricular Course (SS)	YOG/PES/CUL/ NSS/NCC-156-CC	To be selected from the CC Basket	T	02
	Total Credits Semester-II				**22**
	Cumulative Credits Semester-I + Semester-II				**44**

Course Structure for S.Y.B.Sc. (2024 Pattern) as per NEP-2020

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
III (5.0)	Major Mandatory	PHY-201-MRM	Mathematical Methods in Physics	Theory	02
	Major Mandatory	PHY-202-MRM (A)/ PHY-202-MRM (B)	Analog Electronics/ Instrumentation-I	Theory	02
	Major Mandatory	PHY-203-MRM	Major Physics Practical–I	Practical	02
	Vocational Skill Course (VSC)	PHY-204-VSC	Python Programming in Physics	Practical	02
	Field Project (FP)	PHY-205-FP	Field Project	Practical	02
	Minor	PHY-206-MN	Basic Physics	Theory	02
	Minor	PHY-207-MN	Minor Physics Practical - I	Practical	02
	Open Elective (OE)	PHY-208-OE	Astronomy-I	Theory	02
	Subject Specific Indian Knowledge System (IKS)	PHY-209-IKS	Knowledge System of Bharata	Theory	02
	Ability Enhancement Course (AEC)	MAR-210-AEC/ HIN-210-AEC/ SAN-210-AEC	मराठी भाषेची कौशल्ये -१ हिंदी भाषा : सृजन कौशल Prathamik Sambhashan Kaushalyam	Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS /NCC-211-CC	To be continued from the Semester - II		02
	Total Credits Semester - III				**22**
IV (5.0)	Major Mandatory	PHY-251- MRM	Waves and Oscillations	Theory	02
	Major Mandatory	PHY-252- MRM (A)/ PHY-252- MRM (B)	Digital Electronics/ Instrumentation-II	Theory	02
	Major Mandatory	PHY-253- MRM	Major Physics Practical–I	Practical	02
	Vocational Skill Course (VSC)	PHY-254-VSC	Python Programming in Physics	Theory	02
	Community Engagement Project (CEP)	PHY-255-CEP	Community Engagement Project	Project	02
	Minor	PHY-256-MN	Thermometry	Theory	02
	Minor	PHY-257-MN	Minor Physics Practical - I	Practical	02
	Open Elective (OE)	PHY-258-OE	Astronomy-II	Practical	02
	Skill Enhancement Course (SEC)	PHY-259-SEC	Practical on Data Analysis and Graphing Software	Practical	02
	Ability Enhancement Course (AEC)	MAR-260-AEC/ HIN-260-AEC/ SAN-260-AEC	मराठी भाषेची कौशल्ये -२ हिंदी भाषा : संप्रेषण कौशल Prathamik Sambhashan Kaushalyam	Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS /NCC-261-CC	To be continued from the Semester - III		02
	Total Credits Semester - IV				**22**
	Total Credits Semester – III + IV				**44**

• Programme Outcomes (POs)

PO 1.Comprehensive Knowledge and Understanding

Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.

PO 2. Practical, Professional, and Procedural Knowledge

Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.

PO 3. Entrepreneurial Mindset and Knowledge

Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.

PO 4. Specialized Skills and Competencies

Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.

PO 5. Capacity for Application, Problem-Solving and Analytical Reasoning

Graduates will possess the capacity to apply learned concepts in practical settings, solve complex problems, and analyze data effectively. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.

PO 6. Communication Skills and Collaboration

Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.

PO 7. Research-related Skills

Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.

PO 8. Learning How to Learn Skills

Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.

PO 9. Digital and Technological Skills

Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.

PO 10. Multicultural Competence, Inclusive Spirit, and Empathy

Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.

PO 11. Value Inculcation and Environmental Awareness

Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.

PO 12. Autonomy, Responsibility, and Accountability

Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.

PO 13. Community Engagement and Service

Graduates will actively participate in community-engaged services and activities, promoting societal well-being.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Theory)

Course Code : PHY-251-MRM

Course Title : Waves and Oscillations

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. To learn about scillations and vibrations.
2. To understnad the properties of waves.
3. The course aims at developing a clear understanding of the fundamental concepts in oscillations, sound and waves and the application in real life oscillatory, sound and optical systems, in communication and other applications.
4. Understand wave propagation, including transverse and longitudinal waves and analyze wave characteristics in different media.
5. Use mathematical tools, such as differential equations and Fourier series, to solve problems and analyze wave characteristics.
6. Develop the skills to solve problems related to waves and oscillations and apply the solutions to real-world situations and engineering applications.
7. Define and explain core terms like amplitude, frequency, wavelength, and phase, and understand the physics of oscillatory and wave motion.

Course Outcomes:

After the completion of this course students will be able to:

CO1. Understand the mathematical description of travelling and standing waves.

CO2. Recognize the one-dimensional classical wave equation and its solutions.

CO3. Calculate the phase velocity of a travelling wave.

CO4. Explain in qualitative terms how frequency, amplitude, and wave shape affect the pitch, intensity, and quality of tones produced by musical instruments.

CO5. Understand physical characteristics of SHM and obtaining solution of the oscillator using differential equations

CO6. Calculate logarithmic decrement relaxation factor and quality factor of a harmonic oscillator.

CO7. Application oriented problems

Topics and Learning Points

UNIT 1: Simple Harmonic Oscillations (8L)

1.1 Simple harmonic oscillator and solution of the differential equation

1.2 Physical characteristics of SHM

1.3 Torsion pendulum- Measurements of rigidity modulus

1.4 Compound pendulum- Measurements of "g"

1.5 Examples

UNIT 2: Damped and Forced Oscillations (10L)

2.1 Damped harmonic oscillator solution of the differential equation of damped oscillator

2.2 Energy considerations, logarithmic decrement

2.3 Relaxation time, quality factor

2.4 Differential equation of forced oscillators and its solution

2.5 Amplitude resonance

2.6 Velocity resonance

2.7 Examples

UNIT 3: Wave Motion (12L)

3.1 Concept of wave motion

3.2 Electromagnetic wave and frequency

3.3 Wavelength and wave equation

3.4 Amplitude and period

3.5 Transverse wave on a string

3.6 Travelling and standing waves on a string

3.7 Normal modes of a string

3.8 Plane waves and spherical waves

3.9 Examples

References:

1. Waves and Oscillations: Stephenson
2. The physics of waves and oscillations, N.K.Bajaj, TataMcGraw-Hill,Publishingco.ltd.
3. Fundamentals of vibration and waves,SPPuri, TataMcGraw-HillPublishingco.ltd.
4. Waves and Oscillations, R.N.Chaudhari, Newage international (p) ltd.
5. University Physics. FWSears,MW Zemansky and HDYoung13/e, 1986.Addison-Wesley
6. Sound, Mee, Heinmann,Edition-London

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Waves and Oscillations **Course Code**: PHY-251-MRM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	1	1	1	2	1	1	3	1	1	1	1	1
CO 2	3	2	1	2	3	1	2	3	1	1	1	1	1
CO 3	2	2	1	3	3	1	1	3	2	1	1	2	1
CO 4	2	2	1	2	2	2	1	3	1	1	1	1	1
CO 5	3	2	1	3	3	1	2	2	1	1	1	2	1
CO 6	2	3	1	3	3	1	2	2	1	1	1	2	1
CO7	2	3	2	3	3	2	2	2	1	1	1	3	1

Justification

PO1: Comprehensive Knowledge and Understanding – 3

CO1, CO2, CO5 provide a deep understanding of the theoretical foundations of waves and oscillations, including the classical wave equation, SHM, and oscillator models. These form the conceptual backbone of physical sciences, aligning directly with PO1.

PO2: Practical, Professional, and Procedural Knowledge – 2

CO7 (application-oriented problems) and CO6 (quality factor, relaxation) develop procedural and analytical knowledge relevant to laboratory and real-world problem-solving contexts. Students learn to apply theories to practice, though hands-on experimental application may be moderate.

PO3: Entrepreneurial Mindset and Knowledge – 1

Indirect relation. While the course does not explicitly focus on entrepreneurship, analytical thinking and problem-solving (CO7) can support innovative approaches in acoustics, instrumentation, or applied physics.

PO4: Specialized Skills and Competencies – 3

CO3, CO6, and CO7 strongly contribute by developing computational, analytical, and technical proficiency—skills central to physics and engineering applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning – 3

CO3, CO5, CO6, and CO7 emphasize analytical reasoning, quantitative calculations, and solving real-world problems such as determining oscillation parameters or analyzing sound properties—directly fulfilling PO5.

PO6: Communication Skills and Collaboration – 2

CO4 requires qualitative explanations of physical concepts, fostering communication clarity in scientific contexts. Collaboration may occur through discussions and lab problem-solving, hence moderate mapping.

PO7: Research-related Skills – 2

CO2, CO5, and CO6 involve derivations and data interpretation that mirror foundational research processes such as modeling and analysis, though advanced research design is not a major focus.

PO8: Learning How to Learn Skills – 3

CO1–CO7 together develop independent learning through conceptual understanding, problem-solving, and mathematical analysis—helping students acquire lifelong learning skills.

PO9: Digital and Technological Skills – 2

If computational tools or simulations are used for wave analysis (CO6, CO7), students gain experience in using software for data computation and modeling—moderate linkage.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – 1

Minimal direct linkage. The content is scientific rather than social in focus, though group learning may foster basic teamwork and inclusiveness.

PO11: Value Inculcation and Environmental Awareness – 1

Weak relation. While not directly addressed, understanding acoustics and vibrations may indirectly promote awareness of noise pollution or environmental sound management.

PO12: Autonomy, Responsibility, and Accountability – 2

Through solving complex assignments (CO7) and working independently on problem sets, students demonstrate responsibility and accountability in applying learned concepts.

PO13: Community Engagement and Service – 1

Weak relation. The course primarily addresses theoretical and applied physics rather than community-based learning, though understanding sound and vibrations can have societal applications (e.g., acoustic design, noise control).

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Theory)

Course Code : PHY-252- MRM (A)

Course Title : Digital Electronics

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

The course objectives of this syllabus typically to focus on equipping students with knowledge and skills related to the design, analysis, and application of digital systems. Following are the course objectives of this course:

1. Learn the basic concepts of digital electronics, including binary systems, Boolean algebra, and logic gates.
2. Develop skills in analysing and designing combinational circuits like multiplexers, decoders, encoders, and arithmetic circuits (e.g., adders, subtractors).
3. Study the principles of flip-flops, counters, registers, and state machines.
4. Master binary, octal, hexadecimal number systems and understand binary arithmetic.
5. Use Karnaugh maps and Boolean algebra simplification techniques to minimize logic circuits.
6. Gain hands-on experience with simulation toolsto design and test digital circuits.
7. Understand the practical applications of digital circuits.

Course Outcomes:

On successful completion of this course students will be able to do the following:

CO1. Students will be able to explain the fundamental concepts of digital logic, including binary systems, logic gates, and Boolean algebra.

CO2. Students will be able to design and analyse combinational logic circuits such as adders, multiplexers, decoders, and encoders.

CO3. Students will be able to design and implement sequential circuits like flip-flops, registers, counters.

CO4. Students will demonstrate the ability to simplify complex Boolean expressions using Karnaugh maps and Boolean algebra to optimize circuit designs.

CO5. Students will understand different number systems (binary, octal, decimal, hex)

CO6. Students will gain hands-on experience using simulation softwareto design, simulate, and test digital circuits.

CO7. Students will develop problem-solving abilities and thinking skills.

Topics and Learning Points

UNIT 1: Number System and Boolean Algebra (10L)

1.1 Binary Number system, Decimal to Binary and Binary to Decimal Conversion

1.2 Octal Numbers, Hexadecimal Numbers, and conversions

1.3 ASCII code, Excess-3 code, Gray Code

1.4 Basic Gates- AND, OR and NOT Gates, XOR and XNOR Gates,

1.5 NAND and NOR Gates as Universal Gates

1.6 Binary Addition, Binary Subtraction using 2's Complement Method

1.7 Boolean Laws. Simplification of Logic Circuit using Boolean algebra

1.8 De Morgan's Theorems

UNIT 2: Combinational Circuit (10L)

2.1 Introduction to SOP and POS techniques

2.2 Reduction of Boolean expression using K-map methods (up to 4 variables)

2.3 Design of half adder, full adder,half subtractor, full subtractor

2.4 Introduction to multiplexer (2: 1 &4:1)

2.5 Introduction to demultiplexer (1:2 &1:4)

UNIT 3: Sequential Circuit (10L)

3.1 Flipflops RSflip flop using NAND and NOR gates

3.2 Clocked RS, D, JK, and T flip flops, preset and clear inputs

3.3 Counters 4-bit ripple counter, 4-bit parallel counter

3.4 Registers, Buffer registers (SISO, SIPO, PISO, PIPO) use of register as a memory

References:

1. Digital Fundamentals by T. L. Floyd, Pearson International Publications, Ninth Edition, 2000.
2. Electronics Principles by Malvino and Leach, Mc. Graw Hill, Third edition. 2000.
3. Modern Digital Electronics by R P Jain, Tata McGraw-Hill Education, 2003.
4. Electronics Analog and Digital by I. J. Nagrath, PHI Learning Pvt. Ltd., 2013 Edition.
5. Principles of Digital Electronics by K. Meena, PHI Learning Pvt. Ltd., Fourth Printing, 2013.
6. Basic Electronics by R. S. Sedha, S. Chand publication

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Digital Electronics **Course Code**: PHY-252- MRM (A)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	2	1	1	2	1	1	1	1	1
CO 2	3	3	1	3	3	2	2	2	2	1	1	2	1
CO 3	3	3	1	3	3	2	2	2	2	1	1	2	1
CO 4	3	2	1	3	3	1	1	2	1	1	1	1	1
CO 5	3	2	1	2	2	1	1	2	1	1	1	1	1
CO 6	2	3	1	3	3	2	2	3	3	1	1	2	1
CO7	2	2	2	3	3	2	2	3	2	1	1	3	1

Justification

PO1: Comprehensive Knowledge and Understanding – 3

CO1, CO2, CO3, CO4, and CO5 directly build a strong conceptual foundation in digital logic, Boolean algebra, and number systems. These are the core theoretical principles essential for any electronics or computer engineering graduate. Students gain a comprehensive understanding of how logical operations underpin all digital systems.

PO2: Practical, Professional, and Procedural Knowledge – 3

CO2, CO3, and CO6 strongly align with this PO as students learn to design and simulate logic circuits using professional tools and methodologies. The course also emphasizes accuracy, procedural design flow, and real-world circuit applications, aligning well with industry-relevant practices.

PO3: Entrepreneurial Mindset and Knowledge – 1

Indirect relation. While the course is technical in nature, the problem-solving and design-thinking approach (CO7) can foster innovation and creativity useful in entrepreneurial contexts such as embedded system design or automation startups.

PO4: Specialized Skills and Competencies – 3

CO2, CO3, CO4, CO6, and CO7 develop specialized skills such as logical reasoning, design optimization, and circuit analysis. These are critical technical competencies that enable students to adapt and innovate in electronics and computer hardware-related fields.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning – 3

CO2, CO3, CO4, and CO7 strongly contribute to problem-solving and analytical reasoning. Students learn to identify problems, analyze logical requirements, and implement efficient circuit designs—skills essential for engineering reasoning and innovation.

PO6: Communication Skills and Collaboration – 2

While the course is technical, students often work in groups for lab simulations (CO6) and circuit design discussions. They learn to document results, communicate logic design ideas, and explain circuit behavior clearly, contributing to effective technical communication.

PO7: Research-related Skills – 2

CO6 and CO7 moderately relate as students use simulation tools to test hypotheses about circuit behavior, interpret results, and refine designs. This iterative approach mimics the research process of experimentation and analysis.

PO8: Learning How to Learn Skills – 3

All COs encourage independent learning through problem-solving, debugging, and self-directed exploration of circuit behavior. Students develop the ability to learn new technologies or logic families independently—a key lifelong learning trait.

PO9: Digital and Technological Skills – 3

CO6 directly addresses the use of simulation software and digital design tools. Students gain proficiency with ICT and digital analysis platforms, building confidence in applying technology to engineering problems.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – 1

The relationship is minimal. However, teamwork (CO6) and collaborative lab exercises can encourage inclusivity and respect for diverse viewpoints in group design contexts.

PO11: Value Inculcation and Environmental Awareness – 1

Weak relation. While not explicitly covered, awareness of sustainable hardware design and energy-efficient circuit implementation could subtly connect with environmental consciousness.

PO12: Autonomy, Responsibility, and Accountability – 2

CO6 and CO7 involve completing design and simulation tasks independently. Students take ownership of their learning process and are accountable for circuit accuracy and reporting, reflecting responsibility in engineering practice.

PO13: Community Engagement and Service – 1

Indirect relation. While community application is limited, digital logic concepts can later contribute to technology-driven community solutions such as automation, education tools, or low-cost circuit designs.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Theory)

Course Code : PHY-252- MRM (B)

Course Title : Instrumentation-II

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

The main objectives of this course are to:

1. Understand the principles of pressure and flow measurement using mechanical and electrical transducers.
2. Familiarize students with analog signal conditioning techniques used in instrumentation systems.
3. Develop knowledge of operational amplifiers and their applications in measurement circuits.
4. Learn the working and configuration of instrumentation amplifiers and active filters.
5. Understand various display devices such as CRO, DSO, LED, OLED, AMOLED and LCD.
6. Develop analytical and problem-solving skills through numerical and circuit-based exercises related to measurement systems.
7. Understand the principles of measurement, different types of measuring instruments, and the static and dynamic characteristics of measurement systems.

Course Outcomes:

On successful completion of this course students will be able to do the following:

CO1: Explain the concepts of pressure, vacuum, and different methods for measuring pressure using elastic and electrical transducers.

CO2: Describe various types of flow meters and explain their working principles and applications.

CO3: Understand the steps and importance of analog signal conditioning and impedance matching in instrumentation systems.

CO4: Analyze the characteristics and operation of OP-AMPs and their use in precision measurement circuits.

CO5: Design and implement basic instrumentation amplifier circuits and active filter configurations for signal processing.

CO6: Identify and explain the working principles and applications of different display devices (CRO, DSO, LED, OLED, AMOLED, LCD).

CO7: Solve numerical and application-based problems related to measurement, signal conditioning, and display instrumentation.

Topics and Learning Points

UNIT 1: Measurement of Pressure and Flow **(12L)**

1.1 Revision -Unit of pressure, concept of vacuum, absolute gauge, and differential pressure

1.2 Elastic transducer – diaphragm, corrugated diaphragm, bellows, Bourdon tube

1.3 Electric type - LVDT, strain gauge

1.4 Flow meters- Introduction, definition and units, classification of flow meters

1.5 Mechanical type flow meter- orifice plate, venture tube, flow nozzle

1.6 Electric type flow meter-electromagnetic flow meter, ultrasonic flow meters.

1.7 Problems

UNIT 2: Analog Signal Conditioning **(10L)**

2.1 Steps involved in Signal Conditioning, impedance matching

2.2 OP-AMP and its characteristics (ideal and practical), basic modes of operation

2.3 OP-AMP circuit used in instrumentation –precision rectifier, comparator, logarithmic amplifier, current to voltage and voltage to current converters

2.4 Instrumentation amplifier (Three OP-AMP configuration)

2.5 Active Filters-Low pass, High pass, band pass and band reject filter

2.6 Problems.

UNIT 3: Display Devices **[08]**

3.1 Cathode ray Oscilloscope (CRO)- block diagram of general purpose oscilloscope and its basic applications

3.2 Digital storage oscilloscope (DSO)

3.3 LED display-OLED and AMOLED

3.4 LCD display

References:

1. A course in Electrical and Electronic Instrumentation - A. K. Sawhney (Dhanpat Rai & Co. Pvt. Ltd., New Delhi)
2. Instrumentation devices and systems- Rangan, Sarma, Mani [Tata McGraw Hill]
3. Instrumentation Measurement and Analysis – Nakra, Choudhari [Tata McGraw Hill]
4. Electronics Instrumentation – H. S. Kalsi [Tata McGraw Hill]
5. Sensor and Transducers – Patrabnis [PHI]
6. Fundamental of Industrial Instrumentation- Alok Barua [Wiley India]
7. Instrumentation, measurement and systems-Nakra and Chaudhary

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Instrumentation-II **Course Code**: PHY-252- MRM (B)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	2	1	1	2	1	1	1	1	1
CO 2	3	3	1	2	3	1	1	2	2	1	1	1	1
CO 3	3	2	1	2	3	1	2	3	2	1	1	2	1
CO 4	3	3	1	3	3	2	2	3	3	1	1	2	1
CO 5	3	3	1	3	3	2	2	3	3	1	1	3	1
CO 6	2	3	1	2	2	2	1	2	3	1	1	2	1
CO7	2	3	2	3	3	2	2	3	3	1	1	3	1

Justification

PO1: Comprehensive Knowledge and Understanding – 3

CO1, CO2, CO3, and CO4 provide a solid theoretical foundation in measurement principles, transducers, signal conditioning, and instrumentation systems. These form the fundamental conceptual base of instrumentation engineering, directly aligning with PO1.

PO2: Practical, Professional, and Procedural Knowledge – 3

CO5, CO6, and CO7 develop hands-on experience with practical instrumentation setups, amplifiers, and display systems. The focus on real-world applications, standards, and measurement techniques aligns strongly with industry-relevant procedural knowledge.

PO3: Entrepreneurial Mindset and Knowledge – 1

Indirect linkage. While the course doesn't explicitly address entrepreneurship, CO7's focus on applying instrumentation principles can support innovation in sensor technology, industrial automation, or startup ventures involving smart measurement systems.

PO4: Specialized Skills and Competencies – 3

CO4, CO5, and CO7 foster specialized technical and analytical competencies, including circuit design, signal processing, and troubleshooting. Students gain essential professional skills to innovate and adapt instrumentation systems to varied applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning – 3

CO3, CO4, CO5, and CO7 directly contribute by encouraging problem-solving, data analysis, and design optimization of measurement and signal conditioning systems. Students apply learned concepts to interpret and solve complex real-world measurement challenges

PO6: Communication Skills and Collaboration – 2

Students often document experimental work, present results, and discuss circuit designs in teams (CO5, CO7). This helps develop both written and verbal technical communication, as well as collaborative project work.

PO7: Research-related Skills – 2

CO3, CO4, and CO5 moderately align with research-related skills. Students explore instrumentation design problems, collect and analyze data, and interpret results—laying a foundation for experimental research in instrumentation.

PO8: Learning How to Learn Skills – 3

Throughout all COs, particularly CO4–CO7, students engage in self-directed learning to understand complex circuit behaviors, new measurement techniques, and advanced display technologies, fostering adaptability and continuous learning habits.

PO9: Digital and Technological Skills – 3

CO4, CO5, and CO6 have a direct link as students utilize digital instruments (DSO, CRO), electronic components, and software tools for signal analysis and display applications—enhancing their ICT and technology proficiency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – 1

Weak relation. The course content is primarily technical, though teamwork during lab sessions may encourage inclusivity, cooperation, and mutual respect in diverse group settings.

PO11: Value Inculcation and Environmental Awareness – 1

Minimal direct relation. However, awareness of safe, ethical, and sustainable practices in electronic design and e-waste management may indirectly connect this PO with the responsible use of instrumentation technology.

PO12: Autonomy, Responsibility, and Accountability – 2

CO5 and CO7 promote independent circuit design, testing, and troubleshooting. Students must manage tasks responsibly and ensure accurate measurements, reflecting accountability in engineering work

PO13: Community Engagement and Service – 1

Weak relation. While the course doesn't directly focus on community service, the principles learned can later be applied to develop measurement solutions for societal needs—such as environmental monitoring or healthcare instrumentation.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Practical)

Course Code : PHY-253- MRM

Course Title : Major Physics Practical-I

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1. To help develop habit of practice in the experimental skill developments.
2. To develop experimental skills in due course of time.
3. To introduce students to different apparatus & instruments and demonstrate the skill based experiments.
4. To explain association between theoretical ideas and experimental skills.
5. To emphasize the need of practice in the skill developments.
6. To develop experimental skills in due course of time.
7. To help grow confidence while performing the practical individually.

Course Outcomes:

On successful completion of this course the students will be able to do the following

CO1: Application of Oscillatory Motion: Students will understand and experimentally verify the principles of simple harmonic motion (SHM) and damped and forced oscillations

CO2: Wave Propagation and Speed Determination: Students will be able to experimentally measure the speed of sound in different media and demonstrate the relationship between wave speed, frequency, and wavelength

CO3: Mastery of Optical Instruments: Students will develop hands-on skills with optical instruments, including microscopes, spectrometers etc, for the precise measurement of optical properties

CO4: Light Phenomena Experimentation: Students will conduct experiments on interference, diffraction, and polarization of light, gaining a deeper understanding of wave nature and principles of light.

CO5: Circuit Design and Logic Implementation: Students will design and implement basic digital circuits, using logic gates to create functional systems that perform binary operations such as addition, subtraction, and logic switching

CO6: Use of Measurement Tools: Students will learn to use multimeter, oscilloscopes, and function generators for digital and analog signal measurements in the context of electronics experiments.

CO7: Problem-Solving Skills: Students will develop the ability to troubleshoot and solve problems that arise during experimental setups in the fields of waves, optics, and electronics.

List of Experiments: (Students have to perform Any 8 Experiments)

Section I: Waves & Oscillations

1. Logarithmic decrement (in air and water).
2. Study of coupled oscillators comprising two simple pendulum (Mechanical) and determination of coupling coefficient.
3. ‘g’ by bar pendulum.
4. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, Teflon, paper etc.).
5. Directional characteristics of Microphone.
6. Velocity of sound by Phase shift method.

Section II :Digital electronics

1. Logic Gates (Basic Universal De Morgan’s Theorems)
2. Half/full adder using gates
3. Half/full subtractor using gates

Section III: Optics

1. Dispersive power of glass prism.
2. Total internal reflection using LASER beam and glass prism
3. Diffraction at the edge of a razor blade
4. Optical activity of sugar solution using Polarimeter
5. Goniometer to determine cardinal points and focal length
6. Double refracting prism

2. Student Involvement (Any one equivalent to two experiments)

1.Mini Projects

Group of 4 students should carry out mini project with the report.

Students have to perform at least one additional activity out of three activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to ten experiments.

OR

2. Industrial Visit /Study Tour / Field Visit

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Major Mandatory (Practical) **Course Code**: PHY-253- MRM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	3	1	2	2	1	1	1	2	1
CO 2	3	2	1	2	3	1	2	2	1	1	1	2	1
CO 3	3	3	1	3	3	1	2	2	2	1	1	2	1
CO 4	3	3	1	3	3	1	3	2	2	1	1	2	1
CO 5	3	3	2	3	3	1	2	2	3	1	1	3	1
CO 6	3	3	1	3	3	1	2	2	3	1	1	3	1
CO7	3	3	1	3	3	2	3	3	3	1	1	3	2

Justification

PO1: Comprehensive Knowledge and Understanding — Strong (3)

All COs emphasize understanding fundamental theories of oscillations, waves, optics, and basic electronics, forming the conceptual foundation of experimental physics.

PO2: Practical, Professional, and Procedural Knowledge — Strong (3 for CO3–CO7, 2 for CO1–CO2)

Students gain practical experience through experiments and use of professional tools like CROs, function generators, and spectrometers, following standard lab procedures and safety norms.

PO3: Entrepreneurial Mindset and Knowledge — Weak–Moderate (1–2)

Though not directly entrepreneurial, experimentation and circuit design (CO5) foster innovation and creativity, which are core entrepreneurial qualities.

PO4: Specialized Skills and Competencies — Strong (3)

Hands-on proficiency in instrumentation, measurements, and circuit design aligns with the development of technical competencies and problem-solving abilities.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning — Strong (3)

Students apply theoretical concepts to practical setups, analyze results, and solve numerical/experimental challenges, especially in CO1, CO2, CO5, CO7.

PO6: Communication Skills and Collaboration — Moderate (1–2)

Collaborative lab work and preparation of experimental reports promote communication and teamwork, though not a central focus.

PO7: Research-related Skills — Moderate to Strong (2–3)

Students develop observation, inquiry, and data interpretation skills, particularly in experiments involving wave optics and circuit measurements (CO3, CO4, CO7).

PO8: Learning How to Learn — Moderate (2)

Experiments encourage self-directed learning, requiring students to understand procedures and troubleshoot issues independently.

PO9: Digital and Technological Skills — Strong (3 for CO5–CO7)

Students operate digital instruments (CRO, logic circuits, function generators) and handle data acquisition, strengthening their technological competency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy — Weak (1)

Minimal direct connection; teamwork and peer interaction promote inclusivity indirectly.

PO11: Value Inculcation and Environmental Awareness — Weak (1)

Ethical and safe lab practices instill responsibility, though environmental awareness is only indirectly relevant.

PO12: Autonomy, Responsibility, and Accountability — Strong (3 for CO5–CO7, 2 for others)

Independent performance in experiments and project work enhances self-discipline, accountability, and reliability.

PO13: Community Engagement and Service — Weak–Moderate (1–2)

Indirect linkage through awareness of technology's role in society (e.g., sound, optics, electronics in communication and healthcare).

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : VSC (Theory)

Course Code : PHY-254-VSC

Course Title : Python Programming in Physics

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. To understand the object-oriented concepts using Python in problem solving.
2. To understand the fundamentals of Python programming concepts and its applications.
3. To elucidate solving Physics problems using Python programming language
4. To train the students in solving computational physics problems
5. It aims to equip students with the skills to solve physics problems using Python, including understanding algorithms, implementing them in code, and visualizing/analyzing results.
6. To provide students with a strong foundation in Python programming, including variables, data types, loops, conditionals, functions, and classes.
7. To help students develop the ability to approach and solve physics problems using Python programming techniques.

Course Outcomes:

After completion of the course, the student should be able to:

CO1: Apply the knowledge of Physical science to solve complex real-life Physics problems.

CO2: Identify, formulate, review research literature, and analyze complex Physics problems and reaching substantiated conclusions.

CO3: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusion.

CO4: Demonstrate knowledge and understanding of the Physics and Python programming

CO5: Develop a solid understanding of the Python programming language.

CO6: Apply Python programming to solve physics problems numerically.

CO7: Gain hands-on experience in implementing Monte Carlo simulations using Python.

Topics and Learning Points

UNIT 1: Basics of Python Programming **(08L)**

1.1 Introduction to Python and installation

1.2 Variables, data types, operators, and expressions

1.3 Input/output functions and type conversion

1.4 Conditional statements: if, elif, else

1.5 Looping structures: for, while

1.6 Functions: Definition, arguments, return value

UNIT 2: Scientific Tools in Python **(08L)**

2.1 Introduction to NumPy arrays and array operations

2.2 Array creation: zeros (), ones (), arrange (). Linspace()

2.3 Indexing, slicing, and basic math functions

2.4 Introduction to Matplotlib: line plots and scatter plots

2.5 Customizing plots: labels, titles, legends

2.6 Plotting multiple datasets and subplots

UNIT 3: Applications in Physics **[14]**

3.1 Free fall and projectile motion simulation

3.2 Newton's second law: Euler's method for motion

3.3 Simple Harmonic Motion: time evolution and phase diagram

3.Draw a scatter plot to show the relationship between two numerical variables.

3.5 Plot sine and cosine over the range $\{-\pi, \pi\}$.

3.6 Write simple Python program using Arithmetic operators.

References:

1. Core Python Programming– Wesley J. Chun
2. Introduction to Computing and Problem Solving with Python – Jeeva Jose, P. Balasubramanian
3. Programming in Python 3 – Mark Summerfield
4. Python for Data Analysis – Wes McKinney
5. Matplotlib for Python Developers – Sandro Tosi
6. Computational Physics – Mark Newman
7. Python Data Science Handbook – Jake VanderPlas

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Python Programming in Physics **Course Code**: PHY-254-VSC

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	3	3	1	2	2	2	1	1	3	1
CO 2	3	2	1	3	3	1	3	2	2	1	1	3	1
CO 3	3	3	1	3	3	1	3	2	3	1	1	3	1
CO 4	3	3	1	3	3	1	2	3	3	1	1	3	1
CO 5	3	2	1	2	3	1	2	3	3	1	1	3	1
CO 6	3	3	1	3	3	1	2	3	3	1	1	3	1
CO7	3	3	1	3	3	1	3	3	3	1	1	3	1

Justification

PO1: Comprehensive Knowledge and Understanding — Strong (3)

All COs build upon foundational physics and computational concepts. Students connect theoretical physics with computational modeling, integrating concepts from multiple disciplines.

PO2: Practical, Professional, and Procedural Knowledge — Moderate–Strong (2–3)

Students gain procedural skills through coding, debugging, and applying programming tools to simulate and solve physical systems, aligning with professional scientific and engineering practices.

PO3: Entrepreneurial Mindset and Knowledge — Weak (1)

Although not directly entrepreneurial, Python-based problem-solving promotes innovation and analytical thinking useful for developing tech-driven solutions.

PO4: Specialized Skills and Competencies — Strong (3)

Students acquire technical proficiency in numerical modeling, programming, and data analysis—skills that are central to modern research and industrial applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning — Strong (3)

All COs emphasize applying theory to solve real-world and numerical physics problems using Python, demonstrating strong analytical and reasoning skills.

PO6: Communication Skills and Collaboration — Weak (1)

While the course may involve discussions and reporting results, direct communication skill development is limited; however, teamwork in coding or project groups contributes slightly.

PO7: Research-related Skills — Strong (3)

CO2, CO3, and CO7 especially contribute to research aptitude through experiment design, data analysis, and Monte Carlo simulation techniques.

PO8: Learning How to Learn Skills — Strong (3)

Students engage in continuous learning by debugging, exploring libraries, and applying Python concepts beyond class examples—promoting independent, self-directed learning.

PO9: Digital and Technological Skills — Strong (3)

Python programming enhances computational literacy, simulation capabilities, and data processing—essential for modern digital competence in Physics.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy — Weak (1)

The course focus is technical, with minimal direct engagement with multicultural or social aspects.

PO11: Value Inculcation and Environmental Awareness — Weak (1)

Ethical use of data and responsible research conduct are lightly embedded but not central to the course outcomes.

PO12: Autonomy, Responsibility, and Accountability — Strong (3)

Independent problem-solving, coding, and simulation tasks require initiative, accuracy, and accountability in project completion.

PO13: Community Engagement and Service — Weak (1)

Indirect relevance; however, computational skills gained can later be applied to community-oriented scientific or educational initiatives.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Community Engagement Project (Project)

Course Code : PHY-255-CEP

Course Title : Community Engagement Project

No. of Credits : 02

No. of Teaching Hours : 60

Guidelines for Community Engagement Project (CEP)

In NEP 2020 (2024 Pattern) we are offering to UG (Second Year-Forth Semester) students **Community Engagement Project (CEP)** for **TWO (2)** credits i.e. **50 Marks**. The total time allocation for the student to carry out field project is **60 hours**. The actual field work should be carried out after college hours or on holidays.

To carry out the field project work following guidelines should be used:

1. Community-based learning: Students should participate in Community-based learning/projects under the supervision of faculty.
2. A minimum of **30 hours of learning per credit** in a semester is required.
3. Assignment of project topics to individual student or groups of students (2 or 3 students in one group) and one faculty member from the department will act as GUIDE for the student or group of students.
4. If the project is related to survey type work, then prepare questionnaire (20 -30 questions or more) related to their project topic (in Marathi or English). If the project is related to work that does not involve SURVEY work, then the questionnaire part can be replaced accordingly.
5. The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative. If the project is related to other type work (e.g. Data collection, sample collection etc.) then the guide should discuss with student and finalise the methodology for the same.
6. Students should go to their chosen field with the questionnaire and collect the information regarding the questions asked to the concerned people. Collect as much

information as possible by collecting 25 or more questionnaires or enough number of samples or reasonable amount of data. The more the data, the better it will be for analysis.

7. The student should compile all the relevant data and carry out its analysis.
8. Write a project report in the standard format (2 Copies): Index, Chapter-1, Chapter-2, ….. Conclusion, References etc. The report should mention the clear **OUTPUT** drawn from the study. The typed project report should have minimum 25 pages (excluding title, Certificate, index and acknowledgement pages etc.), in Times New Roman with font size 12, and line spacing of 1.5.
9. Submit the project report with the Guide's signature to the department.
10. The Oral presentation for all the projects in the department should be arranged in the department. To evaluate the project, TWO examiners should be appointed by HoD (The details about appointment of examiners, weightage to internal and external marks etc. will be provided by examination section).
11. The total project work including preparation of questionnaire or sample/data collection to oral presentation should be evaluated for 2 credits (50 Marks).The details about the allocation of time, marks and scheme of examination for field project is given in Table. The departmental CEP coordinator/HoD should submit the marks as per regular procedure to the examination section.
12. Since it is a compulsory subject in our syllabus, passing students in this **Community Engagement Project (CEP)** is **MUST** to complete their degree.

Typical Time and marks allocation for the different stages of the field project is:

Step of Project	**Individual students work in hours**	**Marks**
Topic Selection/ Study Design	05	05
Survey preparation / Fieldwork	25	20
Analysis	10	05
Report writing	20	10
Oral Presentation	-	10
Total	60	50

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Minor (Theory)

Course Code : PHY-256-MN

Course Title : Thermometry

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. Understand the basic principles of temperature measurement.
2. Identify different types of temperature measuring instruments and their applications.
3. Learn calibration methods for temperature measuring instruments.
4. Explore practical applications of thermometry in various fields.
5. A key objective is to learn different temperature scales, including Celsius, Fahrenheit, Kelvin, and Rankine, and to perform accurate conversions between them.
6. The course covers the principles, construction, and working of various temperature sensors, from simple liquid-in-glass thermometers to more advanced devices.
7. Students will gain hands-on experience by performing temperature measurements using various instruments in laboratory settings and practical scenarios.

Course Outcomes:

CO1: Understand the fundamental principles of temperature measurement,

CO2: To understand thermodynamic concepts and temperature scales.

CO3: Demonstrate proficiency in using various temperature measurement techniques and instruments, such as thermocouples, resistance thermometers, and infrared thermometers.

CO4: Apply knowledge of temperature measurement to select appropriate sensors and instrumentation.

CO5: Apply knowledge for specific applications in industries like manufacturing, pharmaceuticals and energy.

CO6: Develop skills in calibrating temperature sensors and instrumentation

CO7: Ensure reliable and precise measurements of temperature.

Topics and Learning Points

UNIT 1: Introduction to Thermometry **(06L)**

1.1 Definition of temperature and its significance in different contexts

1.2 Overview of temperature and its measurement

1.3 Historical development of temperature measurement

1.4 Overview of thermometry and its applications

1.5 Temperature scales: Celsius, Fahrenheit, Kelvin

1.6 Thermometric properties of materials

UNIT 2: Thermometer Calibration **(08L)**

2.1 Principles of calibration

2.2 Calibration standards

2.3 Calibration methods

2.4 Calibration procedures for different types of thermometers

2.5 Uncertainty in calibration and measurement

UNIT 3: Temperature Measuring Instruments **(08L)**

3.1 Introduction to temperature sensors

3.2 Thermometric properties of materials: expansion, electrical resistance & thermoelectric effect

3.3 Different types of thermometers

3.4 Liquid-in-glass

3.5 Bimetallic

3.6 Resistance temperature detectors (RTDs)

3.7 Thermocouples: types, principles, applications

3.8 Thermistors: characteristics, applications

3.9 Pyrometers

UNIT 4: Advanced Topics and Applications **(08L)**

4.1 Infrared thermometers: principles, applications

4.2 Thermal imaging: principles and applications

4.3 Temperature measurement in industrial processes

4.4 Temperature measurement in medical applications

4.5 Emerging trends in thermometry

References:

1. Temperature Measurement by Michalasky (John Wiley and Sons)
2. Introduction to Thermometryby John Doe
3. Temperature Measurement by Thomas Smith

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Thermometry **Course Code**: PHY-256-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	2	1	1	1	2	1	1	1	1
CO 2	3	2	1	2	2	1	1	1	2	1	1	1	1
CO 3	2	3	2	3	3	2	2	2	3	1	2	2	1
CO 4	2	3	2	3	3	2	2	2	3	1	2	2	1
CO 5	2	3	3	3	3	2	2	2	3	1	3	2	1
CO 6	2	3	2	3	3	2	2	2	3	1	2	3	1
CO7	2	3	2	3	3	2	2	2	3	1	2	3	1

Justification

PO 1: Comprehensive Knowledge and Understanding → 3

CO1 and CO2 emphasize understanding the fundamental principles, theories, and concepts of temperature measurement and thermodynamics. This aligns directly with PO1's aim of providing a strong theoretical foundation within a multidisciplinary context.

PO 2: Practical, Professional, and Procedural Knowledge → 3

CO3, CO4, and CO6 involve hands-on experience with instruments, calibration, and real-world application — fulfilling the requirement of professional and procedural knowledge consistent with industry standards and practices.

PO 3: Entrepreneurial Mindset and Knowledge → 2

Through CO5 (industrial applications), learners are exposed to how temperature measurement is crucial in various industrial and commercial contexts, indirectly supporting entrepreneurial understanding of markets and innovation opportunities.

PO 4: Specialized Skills and Competencies → 3

CO3, CO4, and CO6 develop technical proficiency in measurement systems, problem-solving, and analytical abilities, which are essential specialized competencies in engineering and applied sciences.

PO 5: Capacity for Application, Problem-Solving, and Analytical Reasoning → 3

CO4, CO5, and CO7 involve selecting appropriate sensors, applying knowledge to real-world problems, and ensuring measurement precision — all requiring critical thinking, analytical reasoning, and problem-solving.

PO 6: Communication Skills and Collaboration → 2

Students often need to document, interpret, and report experimental data (CO3–CO7) and work collaboratively in laboratories, supporting moderate development of communication and teamwork skills.

PO 7: Research-related Skills → 2

Calibration (CO6) and performance analysis (CO7) involve data collection, observation, and analysis, introducing students to research-oriented approaches and ethical data handling.

PO 8: Learning How to Learn Skills → 2

Students develop self-directed learning through mastering diverse instruments and troubleshooting experimental errors (CO3–CO6), fostering independent and continuous learning habits.

PO 9: Digital and Technological Skills → 3

Temperature measurement and calibration (CO3–CO6) rely on digital sensors, software-based data logging, and automation tools, leading to a strong correlation with digital and technological competency.

PO 10: Multicultural Competence, Inclusive Spirit, and Empathy → 1

Though not directly addressed, collaborative lab work and teamwork promote basic interpersonal respect and inclusivity, but the relation remains weak.

PO 11: Value Inculcation and Environmental Awareness → 2

Temperature monitoring is vital for energy efficiency and sustainability in industries (CO5). Students gain an understanding of environmental responsibility in engineering contexts.

PO 12: Autonomy, Responsibility, and Accountability → 2

Carrying out calibration and precise measurement tasks (CO6–CO7) demands independent work, responsibility, and accuracy, supporting moderate linkage with PO12.

PO 13: Community Engagement and Service → 1

Only weakly related — possible indirect connection through industrial or societal applications of temperature control for public safety and welfare, but not a core focus of this course.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Minor (Practical)

Course Code : PHY-257-MN

Course Title : Minor Physics Practical-I

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1.To understand temperature measurement techniques;

2.To understand thermodynamic background and temperature scales;

3. To understand calibration techniques

4. To explain association between theoretical ideas and experimental skillsof resistance thermometers, thermocouples, radiation thermometers

5. To emphasize the need of practice in the skill developments.

6. To develop experimental skills in due course of time.

7. To help grow confidence while performing the practical individually.

Course Outcomes:

CO1. Students will gain a foundational understanding of the principles behind temperature measurement, including the basic concepts of thermal equilibrium, temperature scales, and types of thermometer

CO2. Students will become proficient in using various thermometric instruments such as mercury thermometers, digital thermometers, thermocouples, and resistance temperature detectors (RTDs).

CO3. Students will learn how to calibrate different types of thermometers, ensuring accurate measurements by using standard reference points (e.g., ice point, steam point)

CO4. Students will understand how temperature measurement techniques are applied in various fields like industrial processes, research, medical sciences, and environmental monitoring.

CO5. Students will develop the ability to analyze errors in temperature measurement and estimate the uncertainty in thermometric readings, considering factors like precision, accuracy, and resolution.

CO6. Students will be able to apply thermometric data to effectively control and regulate temperature in experimental setups, ensuring reliable and reproducible results in practical scenarios.

CO7. Students will be able to collect, analyze, and interpret data from thermometric experiments, demonstrating their ability to report on temperature measurements and draw relevant conclusions based on experimental findings.

List of Experiments: (Students have to perform Any 8 Experiments)

1. Calibration of Thermometers: Compare readings from different thermometers placed in the same environment to understand their accuracy and reliability.

2. Liquid-in-Glass Thermometer Comparison: Compare the readings of a liquid-in-glass thermometer with those of a digital thermometer in various conditions to assess their differences.

3. Thermal Expansion of Liquids: Measure the expansion of a liquid (such as alcohol or mercury) in a glass tube as the temperature changes. Plot a graph of volume against temperature.

4. Thermocouple Calibration: Use a known temperature source (like boiling water or an ice bath) to calibrate a thermocouple thermometer and check its accuracy.

5. Resistance Temperature Detector (RTD) Experiment: Measure the resistance of an RTD sensor at different temperatures and analyze the relationship between resistance and temperature.

6. Thermistor Characterization: Investigate the resistance-temperature relationship (PTC/NTC) of a thermistor by immersing it in water baths of different temperatures and recording its resistance at each temperature.

7. Infrared Thermometer: Use an infrared thermometer to measure the temperature of various objects and surfaces at different distances to understand its accuracy and limitations.

8. Thermal Imaging Experiment: Use a thermal imaging camera to visualize temperature variations on different surfaces and objects and correlate them with actual temperature measurements.

9. Temperature Data Logger Study: Deploy temperature data loggers in various environments (indoors, outdoors, near heat sources, etc.) and analyze the recorded data to understand temperature fluctuations over time.

10. Temperature Measurement in Different Media: Measure the temperature of solids, liquids, and gases using different types of thermometers (e.g., contact thermometers, non-contact infrared thermometers) to understand their suitability

Additional Activities

1. Demonstrations (Any two demonstrations equivalent to two experiments)

2. Computer aided demonstrations using computer simulations or animations (Any one demonstrations equivalent to two experiments) / Virtual lab

2. Student Involvement (Any one equivalent to two experiments)

1.Mini Projects

Group of 4 students should carry out mini project with the report.

Students have to perform at least one additional activity out of three activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to ten experiments.

OR

2. Industrial Visit /Study Tour / Field Visit

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Minor Physics Practical-I **Course Code**: PHY-257-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	2	1	1	1	2	1	1	1	1
CO 2	2	3	1	3	3	2	2	2	3	1	2	2	1
CO 3	2	3	1	3	3	2	3	2	3	1	2	3	1
CO 4	2	3	2	3	3	2	2	2	3	1	2	2	1
CO 5	2	3	2	3	3	2	3	2	3	1	2	3	1
CO 6	2	3	2	3	3	3	3	2	3	1	2	3	1
CO7	2	3	2	3	3	3	3	2	3	1	2	3	1

Justification

PO1 – Comprehensive Knowledge and Understanding (Weight: 3)

Strongly addressed through CO1, which focuses on foundational theories and principles of thermodynamics and temperature scales. This provides students with a conceptual base necessary for advanced applications.

PO2 – Practical, Professional, and Procedural Knowledge (Weight: 3)

CO2, CO3, and CO6 develop procedural and hands-on skills through operation, calibration, and application of thermometric instruments aligned with professional standards.

PO3 – Entrepreneurial Mindset and Knowledge (Weight: 2)

CO4 introduces students to applications of temperature measurement in various industries, enabling them to recognize potential innovation and entrepreneurial opportunities.

PO4 – Specialized Skills and Competencies (Weight: 3)

CO2–CO6 emphasize analytical ability, instrument handling, and problem-solving — essential technical competencies for specialization in instrumentation and applied physics.

PO5 – Capacity for Application, Problem-Solving, and Analytical Reasoning (Weight: 3)

CO5–CO7 directly engage students in error analysis, uncertainty estimation, and data interpretation — key skills that foster analytical reasoning and critical thinking.

PO6 – Communication Skills and Collaboration (Weight: 2)

Through CO7, students prepare reports, interpret experimental data, and present findings. Collaborative lab exercises enhance teamwork and communication.

PO7 – Research-related Skills (Weight: 3)

CO3, CO5, and CO7 involve calibration, error analysis, and experimental interpretation — foundational elements of research methodology and ethical data reporting.

PO8 – Learning How to Learn Skills (Weight: 2)

Independent experimentation and troubleshooting in CO2–CO6 promote self-directed learning, adaptability, and lifelong learning capability.

PO9 – Digital and Technological Skills (Weight: 3)

CO2, CO6, and CO7 involve digital thermometers, RTDs, and data logging systems — building ICT proficiency and digital competency in experimental analysis.

PO10 – Multicultural Competence, Inclusive Spirit, and Empathy (Weight: 1)

While indirectly developed through teamwork and laboratory interactions, this outcome is only weakly linked to course-specific objectives.

PO11 – Value Inculcation and Environmental Awareness (Weight: 2)

CO4 encourages awareness of the role of temperature measurement in environmental and energy systems, fostering responsibility and sustainability awareness.

PO12 – Autonomy, Responsibility, and Accountability (Weight: 3)

CO3, CO6, and CO7 demand accuracy, precision, and ethical responsibility during calibration and reporting — promoting accountability and independent learning.

PO13 – Community Engagement and Service (Weight: 1)

Weak relation; indirect connection arises through understanding industrial and public safety implications of temperature control and measurement systems.

Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2024 Pattern)

Name of the Programme	**:** B.Sc. Physics
Programme Code	**:** USPH
Class	**:** S.Y.B.Sc
Semester	**:** IV
Course Type	**:** OE (Practical)
Course Code	**:** PHY-258-OE
Course Title	**:** Astronomy -II
No. of Credits	**:** 02
No. of Teaching Hours	**:** 60

Course Objectives:

A) अभ्यासक्रमाची उद्दिष्टे

१) विद्यार्थ्यांना दोन ताऱ्यामधील अंतरे कसे काढतात याबद्दल माहिती मिळू शकेल.

२) प्रकाशाच्या विविध गुणधर्माबद्दल माहिती मिळू शकेल.

३) विद्यार्थ्यांना पृथ्वीवरील गुरुत्वाकर्षणबद्दल माहिती मिळू शकेल.

४) विद्यार्थ्यांना दिवस व रात्र का होतात ? याबद्दल माहिती मिळू शकेल.

५) विद्यार्थ्यांना दुर्बिणीचे कार्य व तिचे महत्व याबद्दल माहिती मिळू शकेल.

Course Outcomes:

B) अभ्यासक्रमाची फलिते

CO1. विद्यार्थ्यांना आकाशाबद्दल माहिती होणार आहे. तारे व तारकासमूह याबद्दल माहिती मिळणार आहे.

CO2. गणितीय पद्धतीचा वापर करून दोन ग्रहांमधील अंतरे कशी काढली जातात याची माहिती मिळणार आहे.

CO3. प्रकाशाचे परावर्तन व अपवर्तन काय असते हे सांगू शकतील.

CO4. लोलकाच्या साहाय्याने प्रकाशाचे पृथक्करण कशा प्रकारे होते हे सांगू शकतील.

CO5. प्रयोगशाळेत गुरुत्वाकर्षणाची किंमत कशा प्रकारे काढली जाते हे सांगू शकतील.

CO6. एका सूक्ष्म बिंदूमधून प्रकाशाचे विवर्तन कसे होते ? हे सांगू शकतील.

CO7. वेगवेगळ्या मूलद्रव्यांबद्दल माहिती सांगू शकतील.

Topics and Learning Points

विद्यार्थ्यांना खाली दिलेल्या यादीमधील कोणतेही (आठ) प्रयोग करायचे आहेत.

प्रयोगांची यादी

१) दुर्बिणीचे कार्य व तिचे दैनंदिन जीवनातील उपयोग.

२) प्रकाशाचे विवर्तन कसे होते याचा अभ्यास करणे.

३) दोन ताऱ्यांतील अंतर काढणे.

४) पृथ्वीवरील गुरुत्वाकर्षण मोजणे

५) मूलद्रव्यांचीओळख करून घेणे.

६) प्रकाशाचे अपवर्तन, परावर्तन याचा अभ्यास करणे.

७) प्रकाशाचे विकेंद्रीकरण कसे होते याचा अभयास करणे.

८) दिवस व रात्र का होतात ? याचा अभ्यास करणे.

९) सूर्यग्रहण व चंद्रग्रहण म्हणजे काय ? याचा अभ्यास करणे.

१०) प्रकाशाचे लोलकाच्या साहाय्याने केलेले पृथक्करण याचा अभ्यास करणे.

References:

संदर्भ साहित्य

१. आकाशाशी जडले नाते - डॉ . जयंत नारळीकर

२. वेध अंतराळाचा - लीना दामले

३. अंतराळातील गंमत जंमत - रमेश के महाले

४. ओळख नभांगणाची - हेमंत माने

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Astronomy -II **Course Code**: PHY-258-OE

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	2	1	1	1	2	1	1	1	1
CO 2	3	3	2	3	3	2	2	2	3	1	2	2	1
CO 3	2	3	2	3	3	2	3	2	3	1	2	3	1
CO 4	2	3	2	3	3	2	2	2	3	1	2	2	1
CO 5	2	3	2	3	3	2	2	2	3	1	2	3	1
CO 6	2	3	2	3	3	2	3	2	3	1	2	3	1
CO7	2	2	2	3	3	2	3	2	3	1	3	3	1

Justification

PO1 – Comprehensive Knowledge and Understanding (Weight: 3)

All COs, particularly CO1, CO2, CO3, and CO7, contribute to a strong conceptual foundation in physics — covering astronomy, optics, and atomic theory — helping students understand key scientific principles.

PO2 – Practical, Professional, and Procedural Knowledge (Weight: 3)

CO3–CO6 involve hands-on experiments in reflection, refraction, diffraction, and gravity measurement, giving students practical exposure to physics laboratory procedures.

PO3 – Entrepreneurial Mindset and Knowledge (Weight: 2)

Through CO2 and CO4, students learn problem-solving and innovation in applying physical concepts to real-world systems — moderately supporting entrepreneurial thinking.

PO4 – Specialized Skills and Competencies (Weight: 3)

CO3–CO6 enhance analytical and technical skills in optics, motion, and measurement, equipping learners with specialized competencies for higher-level studies or scientific roles.

PO5 – Capacity for Application, Problem-Solving, and Analytical Reasoning (Weight: 3)

CO2–CO6 involve mathematical modeling, experimental calculations, and data interpretation, strongly supporting the development of analytical reasoning and applied problem-solving.

PO6 – Communication Skills and Collaboration (Weight: 2)

Students present and discuss experimental findings (especially CO7), enhancing oral and written communication and collaborative abilities through group laboratory work.

PO7 – Research-related Skills (Weight: 3)

CO5–CO7 build observation, data analysis, and reporting skills essential for research. Experiments on gravity, diffraction, and spectroscopy foster inquiry-based learning.

PO8 – Learning How to Learn Skills (Weight: 2)

The course encourages independent learning and conceptual understanding of abstract physical phenomena, such as CO2 (planetary distances) and CO6 (diffraction).

PO9 – Digital and Technological Skills (Weight: 3)

Modern laboratory setups often use digital sensors, data acquisition systems, and simulation tools for gravitational and optical experiments (related to CO3–CO6), supporting strong digital competence.

PO10 – Multicultural Competence, Inclusive Spirit, and Empathy (Weight: 1)

Though not directly related to physics concepts, teamwork and collaborative lab sessions promote inclusivity and respect among peers.

PO11 – Value Inculcation and Environmental Awareness (Weight: 2)

Understanding celestial bodies (CO1, CO2) and natural phenomena promotes scientific curiosity, environmental consciousness, and ethical awareness of the universe and energy balance.

PO12 – Autonomy, Responsibility, and Accountability (Weight: 3)

Laboratory experiments such as CO5 (measuring gravity) and CO6 (diffraction) require precision, responsibility, and integrity, directly fostering accountability and self-management.

PO13 – Community Engagement and Service (Weight: 1)

Indirectly related — scientific literacy gained from this course can contribute to public education, outreach, and awareness of scientific advancements.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : SEC (Practical)

Course Code : PHY-259-SEC

Course Title : Practical on Data Analysis and Graphing Software

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1. To help develop habit of practice in the experimental skill developments.
2. To develop experimental skills in due course of time.
3. To introduce students to different apparatus & instruments, and demonstrate the skill based experiments.
4. To explain association between theoretical ideas and experimental skills.
5. To emphasize the need of practice in the skill developments.
6. To develop experimental skills in due course of time.
7. To help grow confidence while performing the practical individually

Course Outcomes:

After successfully completing this laboratory course, the students will be able to do the following:

CO1. Acquire technical and manipulative skills in using laboratory equipment, tools and materials.

CO2. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.

CO3. Demonstrate an understanding of laboratory procedures including safety and scientific methods.

CO4. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.

CO5. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

CO6. To correlate their physics theory concepts through practical

CO7. Students will understand the concept of the moment of inertia (I), which is the rotational equivalent of mass and depends on both the mass of the object and how that mass is distributed relative to the axis of rotation.

List of Experiments: (Students have to perform Any 8 Experiments)

Plotting of graphs using Origin 8 Software

1. Plotting of sinx, cosx, tanx, e^x, trigonometric functions
2. Plotting of e^{-x},logx, lnx, x_n trigonometric functions
3. Plotting of graphs and equations of parabola and hyperbola
4. Plotting of graphs and equations of circle and ellipse
5. Plotting of simple graphs
6. Determination of band gap energy
7. Estimate the crystallite size from the X-ray diffraction peaks
8. Calculate the optical band gap energy from the PL spectroscopy
9. Calculate atomic % of elements based on peak areas from XPS spectroscopy
10. Find out the kinetics of Photocatalytic Reaction

Additional Activities

1. Demonstrations (Any two demonstrations equivalent to two experiments)
2. Computer aided demonstrations using computer simulations or animations (Any one demonstrations equivalent to two experiments) / Virtual lab

2. Student Involvement (Any one equivalent to two experiments)

1.Mini Projects

Group of 4 students should carry out mini project with the report.

Students have to perform at least one additional activity out of three activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to ten experiments.

OR

2. Industrial Visit /Study Tour / Field Visit

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Practical on Data Analysis and Graphing Software **Course Code**: PHY-259-SEC

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	2	3	1	3	2	2	1	2	3	1	2	3	1
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CO 3	3	3	1	2	2	2	2	2	3	1	2	3	1
CO 4	3	2	1	3	3	2	2	3	2	1	1	2	1
CO 5	1	2	1	2	2	3	1	2	2	3	2	2	2
CO 6	3	3	1	2	3	2	2	2	3	1	2	2	1
CO7	3	3	1	3	3	2	1	2	3	1	2	2	1

Justification

PO1. Comprehensive Knowledge and Understanding

Laboratory work directly reinforces theoretical understanding and helps students visualize and experience physical principles.

Strongly mapped (3) with CO3, CO4, CO6, CO7 since they deepen understanding of theories and concepts through practice.

Moderate (2) with CO1, CO2 as they contribute foundational understanding through practical exposure.

PO2. Practical, Professional, and Procedural Knowledge

Students gain hands-on proficiency with laboratory instruments, procedures, and scientific techniques.

Strongly mapped (3) with CO1, CO2, CO3, CO6, CO7 since they directly involve practical application of physics concepts and procedures.

Moderate (2) with CO4, CO5 which involve analytical reasoning and teamwork in lab contexts.

PO3. Entrepreneurial Mindset and Knowledge

While not a primary focus, practical lab exposure can encourage innovation and curiosity—important for an entrepreneurial mindset.

Weak (1) mapping across all COs, reflecting indirect contribution to innovative thinking.

PO4. Specialized Skills and Competencies

Students demonstrate technical precision, analytical ability, and problem-solving in lab experiments.

Strong (3) for CO1, CO4, CO7 due to technical proficiency and application.

Moderate (2) for CO2, CO3, CO5, CO6 reflecting partial development of analytical and communication skills.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

Students interpret experimental data, apply physics concepts, and analyze outcomes critically.

Strong (3) for CO2, CO4, CO6, CO7.

Moderate (2) for CO1, CO3, CO5, which involve procedural aspects and teamwork.

PO6. Communication Skills and Collaboration

Laboratory sessions enhance teamwork, communication of results, and discussion-based learning.

Strong (3) for CO5.

Moderate (2) for CO1, CO2, CO3, CO4, CO6, CO7 reflecting group coordination and documentation efforts.

PO7. Research-related Skills

Students learn observation, experimentation, and interpretation — foundational research skills.

Strong (3) for CO2.

Moderate (2) for CO3, CO4, CO6, CO7.

Weak (1) for CO1, CO5 due to limited research involvement.

PO8. Learning How to Learn Skills

Students engage in self-directed learning and reflection during experimental and post-lab analysis.

Moderate (2) for most COs, and Strong (3) for CO4 due to conceptual exploration and adaptability.

PO9. Digital and Technological Skills

Use of modern lab instruments and software tools for data recording and analysis builds ICT competency.

Strong (3) for CO1, CO2, CO3, CO6, CO7.

Moderate (2) for CO4, CO5 which involve theoretical application or teamwork.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy

Group-based experiments foster inclusivity, teamwork, and appreciation for different perspectives.

Moderate (3) for CO5 (collaborative learning).

Weak (1) for others due to limited direct linkage.

PO11. Value Inculcation and Environmental Awareness

Ethical lab behavior, safe handling of materials, and sustainable lab practices build responsibility.

Moderate (2) for CO1–CO3, CO5, CO6, CO7.

Weak (1) for CO4, with minimal environmental link.

PO12. Autonomy, Responsibility, and Accountability

Students independently perform experiments, maintain discipline, and ensure accuracy.

Strong (3) for CO1, CO3 (handling instruments responsibly)

Moderate (2) for others involving teamwork or guided procedures.

PO13. Community Engagement and Service

While laboratory work is primarily academic, it indirectly fosters societal responsibility and awareness of science’s role in development

Weak (1) mapping overall; Moderate (2) only for CO5 (team-based, socially interactive learning).